

Design, development and delivering a Boiling Water test Loop (BWTL) for INL ATR-NSUF

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Budget: \$7,500

The Advanced Test Reactor (ATR) at Idaho National Laboratory (INL) was designed to perform materials and fuels experiments in an ultra high (neutron) flux environment. The ATR National Scientific User Facility (NSUF) solicits university-led research teams cost-free access to the reactor on the basis of competitive proposal solicitations; currently there are seven university experiments in the reactor or under development. Experiments are currently performed in either pressurized water loops or gas loops. However, the reactor does not possess the capabilities to run tests in a boiling-water environment. This capability is desirable since a large fraction of the world's reactors are based upon boiling-water technologies (BWR-boiling water reactors), which present unique fuel and materials issues. This project will require design of an in-core boiling water test loop (BWTL). We will need to design an ASME-code pressure vessel, which will be exposed to flux 10-15 times greater than a commercial reactor. This vessel will need to be insulated with a flowing gas-gap and separated from the primary coolant system. In-core instrumentation leads, which go in and out of the core and pressure vessel, will need to be wired to a central control unit. The loop would be designed to accommodate a .5" diameter fuel pins from various vendors. This loop needs to be reusable for multiple tests, so a top for the pressure vessel needs to be designed. To-date, the basic structure of the in-core pressure vessel has been determined; however, none of the dimensions have been finalized. Other aspects have not been examined in depth and require designing. Since the loop will be placed inside of an operating reactor, temperature, flow and reactivity measurements need to be made. This is complicated by the fact that the flow is two-phase (boiling flow) and the fact that the reactor has positive void-reactivity. CFD analysis and MCNP calculations will there be required.